Journal of Applied and Advanced Research 2016. 1(1); 40-45
http://www.phoenixpub.org/journals/index.php/jaar

PHOENIX RESEARCH PUBLISHERS

**Research Article – Environmental Biology**

# Phytotoxic Effect to Cockscomb (*Celosia cristata* L.) with Response of Chlorpyrifos Treatments

**M. Santhoshkumar[a], L. Baskaran[a]*, T. Mahakavi[a], R. Bakiyaraj[b] and T.Ravimycin[a]**

[a]*Department of Botany, Annamalai University, Annamalai Nagar-608 002, Tamil Nadu, India*
[b]*Department of Botany,Government Arts College,Thanthonrimalai, Karur - 639 005, Tamil Nadu, India*

## Abstract

The present work was conducted to evaluate the phytotoxic of chlorpyrifos on cockscomb (*Celosia cristata* L.) plant. The seeds was exposed different dosage (control, 0.5, 1, 2 and 2.5%) of chlorpyrifos. On the 7$^{th}$ day seed germination percentage were determined, seedling morphological such as shoot length, root length, biomass and photosynthetic pigments like chlorophyll 'a' and chlorophyll 'b' were examined on 30, 60 and 90 days after treatments. The germination percentage negatively affect with increasing chlorpyrifos level. The morphological and photosynthetic pigments were increases at optimum level (0.5%). Moreover, above the optimum concentration all investigated parameters was decreased with increasing chlorpyrifos level. The obtained results suggest that usage of this insecticide optimum dosage helpful for good agricultural practices.

*Key words*: Pesticides, Chlorpyrifos, *Celosia cristata*, Phytotoxcity, Photosynthetic pigments

## Introduction

Pesticide is specifically planned for the control of pests, weeds or diseases in morden agricultural practices. Application of pesticide is conceived the most effective and accepted means for the protection of plants from pest attack and has significantly brought to eanhance agricultural productivity (Dubey *et al.,* 2015). Annually 4.6 million tons of chemical pesticide and about 500 types of pesticide were used acroos the world (Zhang *et al.,* 2011). Pesticides has become contaminated the soil, surface areas, ground water by the way of spills, acidents, misapplication, and /or runoff and soil erosion (Karthikayen *et al.,* 2004 ;Henderson *et al.,* 2006). Among the pesticide, the chlorpyrifos [O,O-diethyl O-(3,5,6,-trichloro-2-pyridinyl)-phosphorothioate] is an organophosphorus insceticide extensively used to control pests on grain, fruit,cotton, nuts, vegetables crops, as well as lawns and ornamental plants. US-EPA (U.S. Environmental Protection Agency, 2002) has been confined for resedential uses and even some agricultural purposes in united states and some european countries, but in an india it was continousely use to control insects in agricultural crops (Eaton *et al.,* 2008).

In study of (Baig *et al.,* 2003) reported that application of glyphosate gradually declined the germination of seed and shoot fresh weight in pea plant. In the experiment of Stevens *et al.,* 2008, studied that higher dose of imidacloprid significantly effect the germination of rice seedling. The study accounted that Pesticide can reduce the germination percentage and seedling height in barley (Srivastava and Singh, 2009). In earlier report (Kim and Ahn, 2009) suggest that excessive and frequently use of chlorpyrifos might have accumulated in agricultural crops. Previous result reported that chlorpyrifos toxcity in *Brassica chinensis* L. and conclded that chlorpyrifos significantly inhibit root growth ( Zhi-Yong *et al.,* 2011). Earlier report (Basantani *et al.,* 2011) indicate that treatments of glyphosate importantly inhibit the germination percentage, fresh weight and root length of *Vigna radiata*. It has been earlier reported that dimethoate insecticide is toxic effect to the plant growth, photosynthetic pigments and photosynthetic activity in Glycine max L. (Panduranga *et al.,* 2005). Moreover, chlorpyrifos have negative impact on photosynthetic pigment, further increase of higher concentration (Kashyap and Kumar, 2013).Rcently, Santhoshkumar *et al.,* 2015 examined the phytotoxcity of chlorpyrifos in green gram. In the present study, we have studied the effect of chlorpyrifos to establish the differential sensitiviy of *Celosis cristata* L. against imposed pesticide. The study have following objective as follows: (i) to detect the efficiency of the selected pesticide on morphological attribute such as germination percentage of seed, plant height and biomass. (ii) to study the relative effect of selected pesticide on photosynthetic pigments. To our

Received: 21-04-2016; Revised: 16-06-2016; Accepted 17-06-2016; Published Online: 21-06-2016

*Corresponding Author

L. Baskaran, Department of Botany, Annamalai University, Annamalai Nagar – 608 002, Tamil Nadu, India.

knowledge the present investigation is the first report that phytotoxic effect of chlorpyrifos in Cockscomb (*Celosis cristata* L.) plant.

## Materials and Methods

### *Chemicals and Plant material*

The Chlorpyrifos 20% EC was purchased from agroagencies, chidamparam,India. Treatment concentrations were prepared from this solution as 0.5, 1, 2 and 2.5 % .The certified seeds of *Celosia cristata* were collected from the Derpartment of Agriculture, Annamalai University, Annamalanagar, Tamil Nadu. Seeds were surface sterilized with 0.5% sodium hypochloride for 10 min, followed by extensive washing with sterile distilled water. The seeds were placed on two layered moist filter paper in petriplates and placed in an incubator to germinate at 25°C for 7 days. The emrgence of radicle was considered for seed germination. The total germination percentage was calculated by using the formula.

Germination percentage = Total number of seeds germinated/ Total number of seeds sown × 100

### *Morphological parameters*

The morphological parameters including shoot length, fresh weight and dry weight were analysed at the periods of 30, 60 and 90 days after sowing (DAS). For the measurement of shoot and root length, twenty plants were randomly selected from each treatment to record the seedling growth.The growth was measured using a centimeter scale and the values were recorded**.** For the measure of fresh weight and dry weight the plants sample were kept in an hot air oven at 80°C for 24 h. Then, the samples were kept in desiccators and their dry weight was recorded by using an electrical single pan balance. The average was expressed in $g^{-1}$ plant.

### *Photosynthetic pigments estimation*

The photosynthetic pigments chlorophyll 'a', chlorophyll 'b' with 30, 60 and 90 days old *Celosia cristata* was estimated followed by Arnon, (1949) method. Five hundred mg of fresh leaf material was ground in a mortar and pestle with 10 mL of 80 per cent acetone. The homogenate was centrifuged at 800 rpm for 15 min. The supernatant was saved. The residue was re-extracted with 10 mL of 80 per cent acetone. The supernatant was saved and the absorbance values were read at 645 and 663 nm using visible UV-Spectrophotometer (Hitachi). The chlorophyll 'a', chlorophyll 'b' and total chlorophyll contents were estimated and expressed in mg $g^{-1}$ fresh weight basis.

Chlorophyll 'a' = (0.0127) × (O.D 663) – (0.00269) × (O.D 645)

Chlorophyll 'b' = (0.0229) × (O.D 645) – (0.00488) × (O.D 663)

### *Statistical analysis*

All treatments were replicated three times. All presented data are expressed as mean ± standard deviation (SD) of the mean. The statistical graphs were carried out by using Microsoft offices excel.

## Results

### *Effects on seed germination percentage*

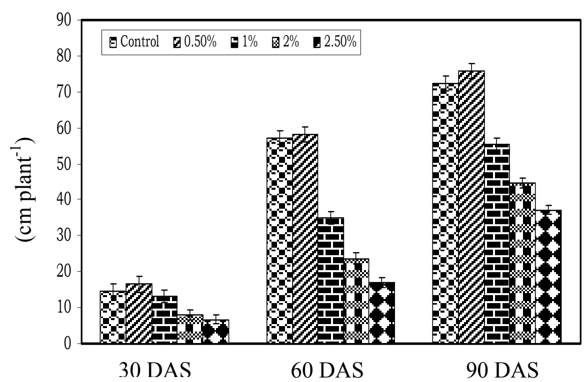
Germonation rate was decreased by 80,66, 53 and 46 % at 0.5, 1, 2 and 2.5%, respectively. The most effect (46%) of chlorpyrifos on seed germination was found at the highest cocentration 2.5%.

### *Effect on morphological parameters*

The effect of different concnetrations of chlorpyrifos on shoot length shown in Fig-1. The shoot length was increased at 0.5% treatment concentration with comparison of 16.5, 58.2 and 75.8 cm respectively, which was compared with control14.7, 57.2 and 72.3 cm. Thereafter, the shoot length was decreased with increasing the concentrations. The most destructive effect on shoot length(6.7, 17 and 37.2 cm) was observed in 2.5% cocncentrtion for all the treatments days.

The effect of root length of chlorpyrifos are depcited in Fig-2. The highest reduction of root length(4.3, 4.7 and 7.4 cm) was observed at the higher concentration of treatments.The fresh weight of plant is shown in F-3. Increaing concentraton of chlorpyrifos affect the fresh wight, the most destructive effect was observed in 2.5% concentration in all the treatments days 2.08, 12.95 and 12.94 g/plant respectively. Dry weight was gradually declined with incease of chlorpyrifos dosage level 0.42, 1.95 and 0.98 g/plant, respectively (Fig-4).

**Fig-1.** An influence of different concentrations of chlorpyrifos on shoot length




### *Influence of chlorpyrifos on chlorophyll content*

The photosynthetic pigment such as chlorophyll'a' and chlorophyll 'b' after the 30, 60 and 90 days, respective treatments are given in Fig-5 and Fig-6. Plant treated with 0.5% of chlorpyrifos exhibited an increase of in the value of chl *a* and chl *b* (3.16, 5.92, 4.6 and 1.93, 2.86, 2.18 mg $g^{-1}$ fr. wt) respectively. In contrast, decrease in chl *a* and chl *b* content was observed in higher concentration (1.45, 3.64, 2.98 and 0.91, 1.95, 0.98 mg $g^{-1}$ fr. wt) respectively.

**Fig-2.** An influence of different concentrations of chlorpyrifos on root length

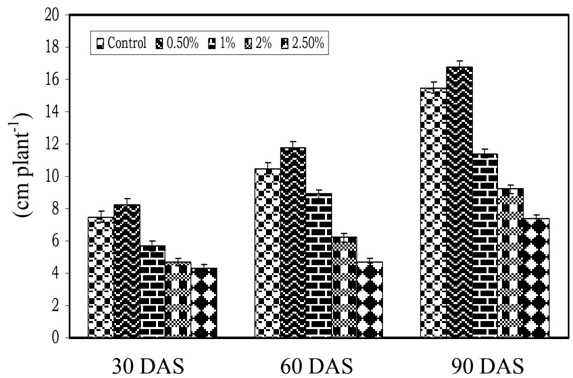



**Fig-3.** An influence of different concentrations of chlorpyrifos on fresh weight

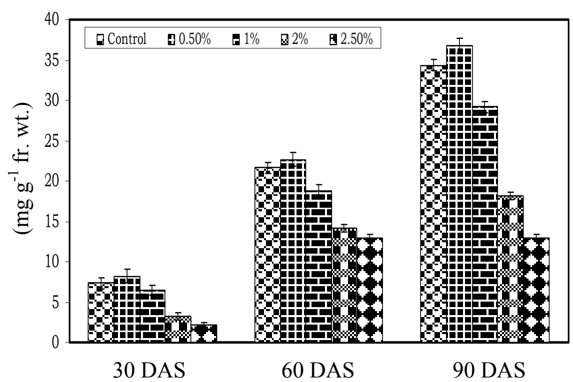
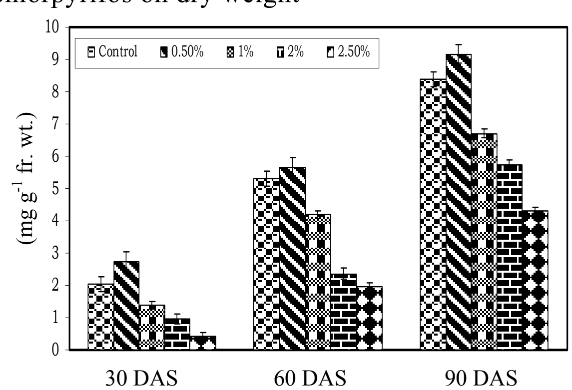



**Fig-4.** An influence of different cocentrations of chlorpyrifos on dry weight




## Discussion

*Plant growth parameters*

The plant growth parameters such as shoot length, root length and biomass (fresh weight and dry weight) was increased at 0.5% of chlorpyrifos when compare to control plants. In contrast, higher concentrations of chlorpyrifos, a declined in above parameters were recorded in all the observed days. Seedling growth prohibition might be due to the inhibition of hydrolytic enzyme synthesis or blocking of enzyme pathway in seed during germination (Gange *et al.,* 1992).

**Fig-5.** An influence of different concentrations of chlorpyrifos on chl *a*

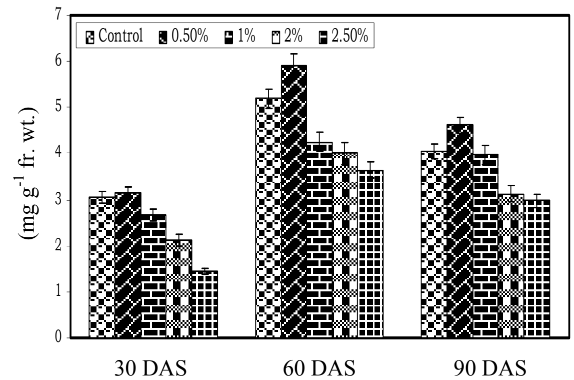
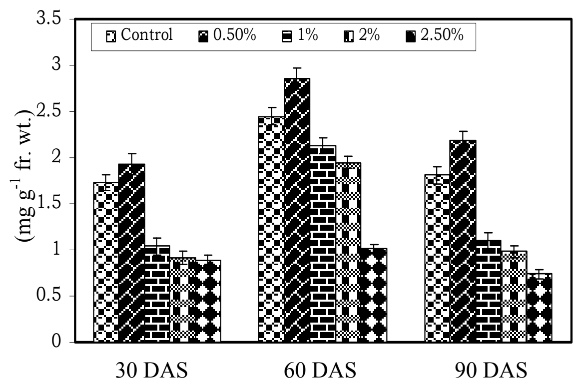



**Fig-6.** An influence of different concentrations of chlorpyrifos on chl *b*




Under abiotic stress including pesticide, the plant activate and formed some phenolic compounds like isoflavones (genistein, diadzein) phenolic acid (elagic, tannic and vanilic acid) and hydroxycinnamic acid derivatives (ferulic acid, ρ-hydroxy benzoic acid and ρ-caumeric acid), could reduce the germination and plant growth (Macias *et al.,* 1992; Mersie and Singh, 1993). Moreover, seed germination is an crucial phase in plant growth, and especially sensitive to stress tolerence against contaminants (Banks and Schultz, 2005). Seed germination percentage may reflect the plants seeds on their living environment (Li *et al.,* 2007). However, overall inhibition in seedling and morphological parameters was observed in *V.mungo* with the application endosulfan (Mishra and Mohanty, 2008). The presence of pesticide residue in soil could inhibit the uptake of micro nutrients and create nutrient deficiency, this may reflect in abnormality in plant growth parameter (Wahengbam *et al.,* 2013).

Recently Bassey *et al.,* 2015 studied the seed germination of soyabean (*Glycin max*) in the treatments of chlorpyriphos and ridomil. They found that seed germination was declined over treatment of pesticides.

Plant morphology is connected with cell division and cell elongation or the conversion of indole-3 acetic acid into different photo oxidative products (Tevivi and Teramura, 1989; Ros and Tevivi, 1995). The shoot and root dry mass was decreased in faba bean when grown in brominal and gramoxone treated soil, even at field condition (Abd-alla and Omar, 1993). On other hand, root and shoot dry weight was declined over the treatment of glyphosate on soybean concluded by King *et al.,* 2001. Insecticide inhibit the plant height with increase of concentration, it might be due to retarded cell growth and division in root Warabi *et al.,* 2001. Liu *et al.,* 2009 observed that the root elongation was decreased with the increasing concentration of pesticide of cypermerthrin in Chinese cabbage (pakchoi) seed. Decrease of root and shoot length with the treatment of dimethoate may be due to arrest of physiological and biochemical process (Mishra *et al.,* 2009). Similar result was observed (Prasertsup and Ariyakanon, 2011) that plant biomass was increased in lowest concentration of chlorpyrifos, but higher concentration decreased in plant biomass in both *Pistia stratiotes* and *L. minor*. As the increase of deltamethrin inhibit the radicle length of root is likely relation to the abnormality of chromosome (Duran *et al.,* 2015).

*Photosynthetic pigment content*

Photosynthetic pigments content such as chlrophyll 'a' and chlorophyll'b' exhibited an increase for 0.5% of chlorpyrifos after all the treatments days over the control plant, but with increase in the concentrations of chlorpyrifos, all the used concentrations of chlorpyrifos inhibit the pigment content. Vermass, 1993 ;Feurtet-Mazel *et al.,* 1996 concluded that phyotoxic effect is depend on the inhibition of photo dependent electron transport in thylakoids, at level of photosysten II (PS II). Sresen *et al.,* 2000 stated that the reduction of chlorophyll content is might be decrease of leaf area with increasing pesticide.Tort and Turkyilmaz, 2003 noted that the application fungicide reduced chl *a,b* and total chlorophyll in pepper leaves with higher dose of fungicide. Mishra *et al.,* 2008 reported that the insecticide could affect photosynthetic system by the inhibition of photo system II and electron chain transport activities. Abhilash and sigh, 2010 stated that the organic pollutant can change the lipid composition of the chloroplast by affecting the photosynthetic pigments and key enzymes. Raja *et al.,* 2012 described that when increase of pesticide concentration the chlorophyll-a, chlorophyll-b and total chlorophyll content was progressively diminished in *Azolla microphylla*. Similar result observed by (Padhy and panigrahi, 2015) described that lower concentration of pesticide increase chlorophyll content whereas, higher concentration of pesticide reduced chlorophyll in *Anabaena cylindrica* Lemm.

## Conclusion

The present studied to assess the effect of chlorpyrifos treatment on seed germination and seedling growth parameters include shoot length, root length, biomass and photosynthetic pigment. The result of this investigation shows that optimum concentration increase all the investigated parameters. While seed germination, seedling parameters as well as photosynthetic (chl *a*, chl *b*) were adversely affect with increasing concentrations. The study suggest that chlorpyrifos is broadly used insecticide, usage of this insecticide optimum dosage helpful for good agricultural practices. This study will help to determine phytoremediation potential of cockscomb plant with response chlorpyrifos contaminated soil.

## Acknowledgement

The authors thank to University of Grand Commission (UGC), Government of India for providing fellowship during this study.

## References

Abd-alla, M.H., Omar, S.A. (1993). Herbicide effects on nodulation, growth and nitrogen yeild of faba bean induced by indigenous *Rhizobium leguminosarium*. *Zentralblatt für Mikrobiologie,* 148: 593-597

Abhilash, P.C., Singh, N. (2010). *Withania somnifera* Dunal-mediated dissipation of lindane from simulated soil: implications for rhizoremediation of contaminated soil. *Journal of Soils and Sediments,* 10: 272–282

Arnon, D.I. (1949). Copper enzymes in isolated chloroplasts. photophenoloxidase in *Beta vulgaris*. *Journal of Plant Physiology,* 24:1-5

Banks, M.K., Schultz, K.E. (2005). Comparison of plants for germination toxicity tests in petroleum contaminated soils. *Water Air & Soil Pollution,* 167: 211– 219

Bassey, I.Y., Effiong, E.B., Archibong, U.D., Ita, W.U. (2015). Germination and root nodule formation of soybean (*Glycine max* (L.) Merr.) in ridomil and chlorpyriphos treated soil. *American Journal of Environmental Protection,* 4 (1): 17-22

Basantani, M., Srivastava, A., Sen, S. (2011). Elevated antioxidant response and induction of tau-class glutathione S-transferase after glyphosate treatment in *Vigna radiata* (L.)

Wilczek. *Pesticide Biochemistry and Physiology,* 99:111–117.

Baig, M.N., Darwent, A.L., Harker, K.N., O'Donovan, J.T. (2003). Preharvest applications of glyphosate affect emergence and seedling growth of field pea (*Pisum sativum*). *Journal of Weed Science and Technology,* 17:655–665.

Dubey, P., Mishra Shukla, A.K., Singh, P.A. (2015). Differential sensitivity of barley (*Hordeum vulgare* L.) to chlorpyrifos and propiconazole: morphology, cytogenetic assay and photosynthetic pigments. *Pesticide Biochemistry and Physiology,* 124:29–36.

Duran, R.E., Kilic, S., Coskun, Y. (2015). Response of maize (*Zea mays* L. saccharata Sturt) to different concentration treatments of deltamethrin. *Pesticide Biochemistry and Physiology,* 124: 15–20.

Eaton, D.L., Daroff, R.B., Autrup, H., Bridges, J., Buffler, P., Costa, L.G., Coyle, J., McKhann, G., Mobley, W.C., Nadel, L., Neubert, D., Schulte-Hermann, R., Spencer, P.S. (2008). Review of the toxicology of chlorpyrifos with an emphasis on human exposure and neurodevelopment. *Critical Reviews in Toxicology,* 38: 1–125.

Feurtet-Mazel, A., Grollier, T., Grouselle, M., Ribeyre, F., Boudou, A. (1996). Experimental study of bioaccumulation and effects of the herbicide isoproturon on freshwater rooted macrophytes (*Elodea densa* and *Ludwigia natans*). *Chemosphere,* 32:1499–1512.

Gange, A.C., Brown, V.K., Farmer, L.M. (1992). Effect of pesticide on the germination of weed seeds: implication of manipulative experiment. *Journal of Applied Ecology,* 29 (2): 303-310.

Henderson, K.L.D., Belden, J.B., Zhao, S.H., Coats, J.R. (2006). Phytoremediation of pesticide wastes in soil. *Zeitschrift für Naturforschung C,* 61: 213–221

Karthikeyan, R., Davis, L.C., Erickson, L.E., Al-Khatib, K., Kulakow, P.A., Barnes, P.L., Hutchinson, S.L., Nurzhanova, A.A. (2004). Potential for plant-based remediation of pesticide-contaminated soil and water using nontarget plants such as trees, shrubs, and grasses. *Critical Reviews in Plant Sciences,* 23: 91–101

Kashyap, V., Mukesh Kumar. (2013). Studies on the effects of Chlorpyrifos on Germination and Photosynthetic Pigments in Green Gram (*Vigna radiata* L.) at Different Phenological Stages. *Journal of Biological and Chemical Research,* 30 (2): 868-874

Kim, J.R., Ahn, Y.J. (2009). Identification and characterization of chlorpyrifos-methyl and 3,5,6-trichloro-2-pyridinol degrading *Burkholderia* sp. strain KR100. *International Biodeterioration and Biodegradation,* 20: 487–497

King, A.C., Purcell, L.C., Vories, E.D. (2001). Plant growth and nitrogenase activity of glyphosate-tolerant soybean in response to glyphosate applications. *Agronomy Journal,* 93: 179–186

Li, C.X., Feng, S.L., Shao, Y., Jiang, L.N., Lu, X.Y., Hou, X.L. (2007). Effect of arsenic on seed germination and physiological activities of wheat seedling. *Journal of Environmental Sciences,* 19 (6): 725-732

Liu, T.F., Wang, T., Sun, C., Wang, Y.M. (2009). Single and joint toxicity of cypermethrin and copper on Chinese cabbage (Pakchoi) seeds. *Journal of Hazardous Materials,* 163: 344–348

Macias, F.A., Galindo, J.C.G., Massanot, G.M. (1992). Potential allelopathic activity of several sesquterpene lactone models. *Phytochemistry,* 31: 1969-1777

Mersie, W., Singh, M. (1993). Phenolic acids affect photosynthesis and protein synthesis by isolated leaf cells of velvet-leaf. *Journal of Chemical Ecology,* 19:1293-1301

Mishra, V., Srivastava, G., Prasad, S.M. (2009). Antioxidant response of bitter gourd (*Momordica charantia* L.) seedlings to interactive effect of dimethoate and UVB irradiation. *Scientia Horticulturae,* 120: 373–378

Mishra, V., Srivastava, G., Prasad, S.M., Abraham, G. (2008). Growth, photosynthetic pigments and photosynthetic activity during seeddling stage of cowpea(*Vigna unguiculata*) in response to UV-B and dimethode. *Pesticide Biochemistry and Physiology,* 92:30-37

Mishra, R.K., Mohanty, B.K. (2008). Effect of an insecticide endocel, 35EC (endosulfan) on the seedling characteristics of green gram *Vigno mungo* L. *Letters in Plant archives,* 8 (2): 877-880

Padhy, R., Panigrahi, A.K. (2015). Pigment analysis of a blue-green alga and use of pesticide: a proportional perspective. *International journal of current research in biosciences and plant biology,* 2 (1): 36-44

Panduranga, M.G., Mahadeva, P.G., Sudarshana, M.S. (2005). Toxicity of different imbibitions periods of dimethoate on germination, chlorophyll a/b, and dry matter of *Glycine max*

(L) Merrill. Cv. KHSB-2, during early seedlings growth. *Physiological Research,* 18:199–201.

Prasertsup, P., Ariyakanon, N. ( 2011). Removal of chlorpyrifos by water lettuce (*Pistia stratiotes* L.) and duckweed (*Lemna minor* L.). *International Journal of Phytoremediation,* 13 (4):383–395

Raja, W., Rathaur, P., Ramteke, P.W., John, S.A. ( 2012). Adverse effects of monocrotophos toxicity on growth and some physiological variables in water fern *Azolla microphylla*. *Journal of Chemical and Pharmaceutical Research,* 4 (2): 1340-1348

Ros, J., Tevini, M. (1995). Interaction of UV-radiation and IAA during growth of seedlings and hypocotyl segments of sunflower. *Journal of Plant Physiology,* 146: 295–302

Santhoshkumar, M., Baskaran, L., Mahakavi, T., Ravimycin, T. (2015). Chlorpyrifos Toxicity in Green Gram (*Vigna radiata* L.). *Journal of Environmental Treatment Techniques, 3 (1): 25-27*

Sresen, F., Kralova, K., Macho, V. (2000). New finding about the inhibitory action of phenyl carbamates and phenyl thiocarbamats on photosynthetic apparatus. *Pesticide Biochemistry and Physiology,* 68:113-118

Srivastava, A.K., Singh, A.K. (2009). Effects of insecticide profenophos on germination, early growth, meiotic behaviour and chlorophyll mutation of barley (*Hordeum vulgare* L.). *Acta Physiologiae Plantarum,* 31: 537–544

Stevens, M., Reined, R.F., Combs, N.E., Helliwell, S., Mo Jianhua. (2008). Influence of imidacloprid seed treatments on rice germination and early seedling growth. *Pest Management Science,* 64:215–222.

Tevini, M., Teramura, A.H. (1989). UV-B effects on terrestrial plants. *Photochemistry and Photobiology,* 50: 463–473

Tort, N., Turkyilmaz, B. (2003). Physiological effects of captan fungicide on pepper (*Capsicum annuum* L.). *Pakistan Journal of Biological Sciences,* 6 (24): 2026-2029

U.S. Environmental Protection Agency (USEPA). Interim reregistration eligibility decision for chlorpyrifos. Prevention, Pesticides and Toxic Substances (7508C), EPA 738-R-01-007; 2002. February 2002.

Vermaas, W. (1993). Molecular-biological approaches to analyze photosystem II structure and function. *Annual Review of Plant Physiology and Plant Molecular Biology,* 44: 457–481

Wahengbam, D., Thoudam, R., Dutta, B.K. (2013). Effect of somr pesticide,fungicide on the germination an growth of seeds/seedlings of crops plant,(i.e. *Cicer arietinum* and *Zea mays*). *Middle-East Journal of Scientific Research,* 17 (5): 627-632

Warabi, E., Usni, K., Tanaka, Y., Matsumoto, H. (2001). Resistance of a soybean cell line to oxyfluorfen by overproduction of mitochondrial protoporphyrinogen oxidase. *Pest Management Science,* 57: 743-748

Zhang, W.J., Jiang, F.B., Ou, J.F. (2011). Global pesticide consumption and pollution: with China as a focus. *Proceedings of the International Academy of Ecology and Environmental Sciences,* 1:125–144

Zhi-Yong, Z., Wei-Li, S., Wen-Cheng, S. (2011). Phytotoxicity and uptake of chlorpyrifos in cabbage. *Environmental Chemistry Letters,* 9 (4): 547-552